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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/589,886

08/18/2006

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EXAMINER

BELOUSOV, ALEXANDER

ART UNIT

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/589,886	Applicant(s) TAKEUCHI ET AL.	
	Examiner ALEXANDER BELOUSOV	Art Unit 2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 May 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 18 August 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>08/18/2006</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

Applicant's election **traverse** of claims 1-10 in the reply filed on 05/29/2008 is acknowledged. **No Claims** are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected group. Election was made **without** traverse in the reply filed on 05/29/2008.

Information Disclosure Statement

The information disclosure statement (IDS) submitted on 08/18/2006. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claim(s) 1-10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The claim limitations of “the diode includes a composition-graded layer having a compositional gradient and being composed of a boron-phosphide-based semiconductor, and the **composition-graded layer serves as the current diffusion layer and the cladding layer**”, as recited in claim(s) 8, are unclear how a new additional element can serve as the previously defined elements.

The claim limitations of “the composition-graded **layer serves as** the current diffusion **layer and** the cladding **layer**”, as recited in claim(s) 8, are unclear how a single layer can be two layers.

The claim limitations of “the composition-graded layer”, as recited in claim 10, are unclear as to what is the composition-graded layer.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. **Claim(s) 1-4, 6, 8 & 10, as best understood**, are rejected under 35 U.S.C. 102(b) as being anticipated by (US-2003/0234400) by Udagawa.

Regarding claim 1, Udagawa discloses in FIG. 6 and related text a compound semiconductor light-emitting diode comprising a light-emitting layer (604) composed of a Group III-V compound semiconductor, and a current diffusion layer (607) provided on the light-emitting layer and composed of a Group III-V compound semiconductor, characterized in that the current diffusion layer is composed of a conductive boron-phosphide-based semiconductor (paragraph 128) and has a bandgap (3.1 eV) at room temperature wider than that of the light-emitting layer (2.9 eV).

Regarding claim 2, Udagawa discloses in FIG. 6 and related text the current diffusion layer (607) is composed of at least one species selected from among boron monophosphide, boron gallium indium phosphide represented by a compositional formula

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$B_{1-\alpha}Ga_{\gamma}In_{1-\alpha-\gamma}P$ ($0 < \alpha \leq 1$, $0 \leq \gamma < 1$), boron nitride phosphide represented by a compositional formula $BP_{1-\delta}N_{\delta}$ ($0 \leq \delta < 1$), and boron arsenide phosphide represented by a compositional formula $B_{1-\alpha}P_{1-\delta}As_{\delta}$. (paragraph 128; “n-type BP”).

Regarding claim 3, Udagawa discloses in FIG. 6 and related text the difference between the bandgap at room temperature (3.1 eV) of the current diffusion layer (607) and the bandgap at room temperature of the light-emitting layer (604; 2.9 eV) accounts for 0.1 eV or more.

Regarding claim 4, Udagawa discloses in FIG. 2 and related text the current diffusion layer (607) has a bandgap at room temperature of 2.8 eV to 5.0 eV (3.1 eV).

Regarding claim 6, Udagawa discloses in FIG. 6 and related text the diode includes, between the current diffusion layer and the light-emitting layer, a cladding layer (605) composed of a Group III-V compound semiconductor, and the cladding layer has a bandgap at room temperature (3.1 eV) wider than that of the light-emitting layer (604; 2.9 eV) and equal to or narrower than that of the current diffusion layer (607; 3.1 eV).

Regarding claim 8, Udagawa discloses in FIG. 6 and related text the diode includes a composition-graded layer (605 & 607) having a compositional gradient (see paragraphs 127 & 128; 605 is n-type boron phosphide and has carrier concentration of $2 \times 10^{18} \text{ cm}^{-3}$; 607 is Si-doped n-type boron phosphide and has carrier concentration of $8 \times 10^{18} \text{ cm}^{-3}$; hence, “having a compositional gradient”) and being composed of a boron-phosphide-based semiconductor, and the composition-graded layer serves as the current diffusion layer (607) and the cladding layer (605).

Regarding claim 10, Udagawa discloses in FIG. 6 and related text an Ohmic contact electrode (608) is joined to the current diffusion layer or the composition-graded layer (607).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. **Claim(s) 5** is rejected under 35 U.S.C. 103(a) as being unpatentable over (US-2003/0234400) by Udagawa.

Regarding claim 5, Udagawa discloses in FIG. 6 and related text substantially the entire claimed structure, as recited in claim(s) 1, including a thickness of 50 nm to 5,000 nm (paragraph 128).

Udagawa does not disclose the current diffusion layer *has a carrier concentration at room temperature of $1 \times 10^{19} \text{ cm}^{-3}$ or more, a resistivity at room temperature of $5 \times 10^{-2} \text{ f2"cm}$ or less.*

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the device of Udagawa with the current diffusion layer *has a carrier concentration at room temperature of $1 \times 10^{19} \text{ cm}^{-3}$ or more, a resistivity at room temperature of $5 \times 10^{-2} \text{ f2"cm}$ or less*, in order to improve the conductivity of the device.

Generally, differences in carrier concentration or resistivity do not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such carrier concentration or resistivity is critical. "[W]here the general conditions of a claim are

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disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). See also In re Hoeschele, 406 F.2d 1403, 160 USPQ 809 (CCPA 1969). For more recent cases applying this principle, see Merck & Co. Inc. v. Biocraft Laboratories Inc., 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied, 493 U.S. 975 (1989), and In re Kulling, 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990).

7. **Claim(s) 7** is rejected under 35 U.S.C. 103(a) as being unpatentable over (US-2003/0234400) by Udagawa in view of (US-2004/0026703) by Adomi et al ("Adomi").

Regarding claim 7, Udagawa discloses in FIG. 6 and related text substantially the entire claimed structure, as recited in claim(s) 1 & 6, except the cladding layer is composed of a Group III-V compound semiconductor *containing aluminum, gallium, and indium*, and the current diffusion layer is composed of a boron-phosphide-based semiconductor containing *at least one species selected from among aluminum, gallium, and indium*.

Adomi discloses in FIG. 2 and related text the cladding layer (43) is composed of a Group III-V compound semiconductor *containing aluminum, gallium, and indium* (paragraph 39; "AlGaInP").

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the device of Udagawa with the cladding layer is composed of a Group III-V compound semiconductor *containing aluminum, gallium, and indium*, and the current diffusion layer is composed of a boron-phosphide-based semiconductor containing *at least one species selected from among aluminum, gallium, and indium*, in order to improve the characteristics of the device by taking advantage of a direct transition material with a large bandgap, well-suited

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for formation of cladding layers (see Adomi, paragraph 39), and in order to use the device in an application capable of transmitting emitted light having a wavelength longer than about 443 nm (see Udagawa, paragraph 99, “boron indium phosphate”), respectively.

8. **Claim(s) 9** is rejected under 35 U.S.C. 103(a) as being unpatentable over (US-2003/0234400) by Udagawa in view of (US-2003/0218180) by Fujiwara.

Regarding claim 9, Udagawa discloses in FIG. 6 and related text substantially the entire claimed structure, as recited in claim(s) 1, including at least one of the current diffusion layer (607) and the cladding layer (605) are composed of an undoped boron-phosphide-based semiconductor to which no impurity element has been intentionally added (no intentional doping is disclosed for layer 605; paragraphs 127 & 128).

Udagawa does not disclose the light-emitting layer *is composed of an aluminum gallium indium phosphide mixed crystal represented by a compositional formula $Al_{sub.X}Ga_{sub.Y}In_{sub.Z}P$ ($0 < X, Y, Z < 1, X+Y+Z=1$)*.

Fujiwara discloses the light-emitting layer *is composed of an aluminum gallium indium phosphide mixed crystal represented by a compositional formula $Al_{sub.X}Ga_{sub.Y}In_{sub.Z}P$ ($0 < X, Y, Z < 1, X+Y+Z=1$)* (paragraph 4; “AlGaInP active layers”).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the device of Udagawa with the light-emitting layer *is composed of an aluminum gallium indium phosphide mixed crystal represented by a compositional formula $Al_{sub.X}Ga_{sub.Y}In_{sub.Z}P$ ($0 < X, Y, Z < 1, X+Y+Z=1$)*, in order to use the device in an application that required the use of orange/yellow light LED (see Fujiwara, paragraph 4).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

References A-I and L are cited as being related to LEDs.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alexander Belousov whose telephone number is 571-270-3209.

The examiner can normally be reached on Monday - Thursday 7:30AM - 5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lynne Gurley can be reached on 571-272-1670. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Alexander Belousov/
Examiner, Art Unit 2811
06/12/2008

/Ori Nadav/
Primary Examiner, Art Unit 2811